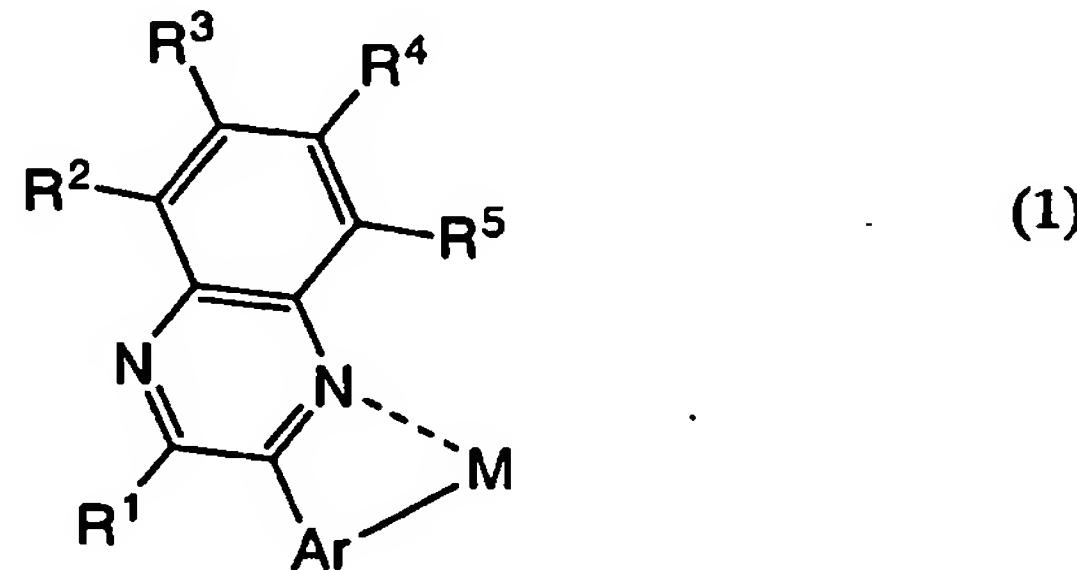


CLAIMS

1. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

5 wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (1) and a compound that has a larger energy gap than the organometallic complex, and

10



15 wherein each of R¹ to R⁵ is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, Ar is one of an aryl group having an electron-withdrawing group and a heterocyclic group having an electron-withdrawing group, and M is one of an element of Group 9 and an element of Group 10.

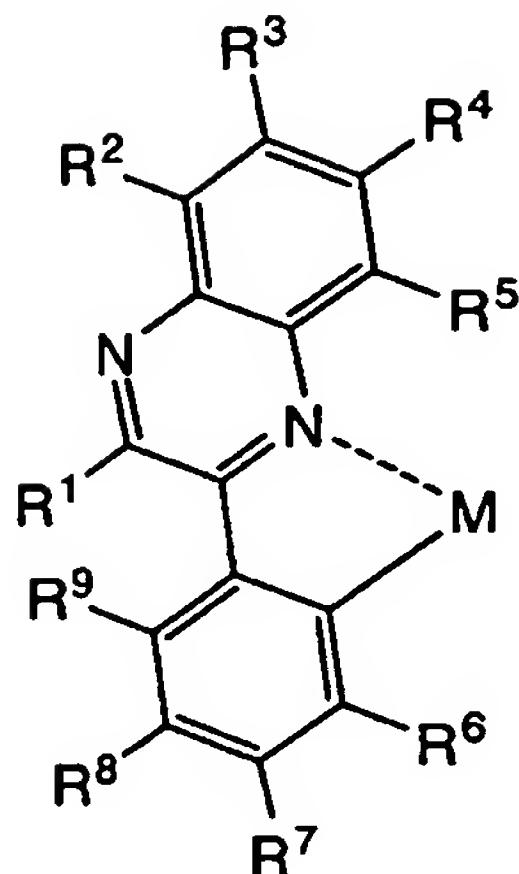
20 2. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

 wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (2) and a compound that has a larger energy gap than the organometallic complex, and

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5



(2)

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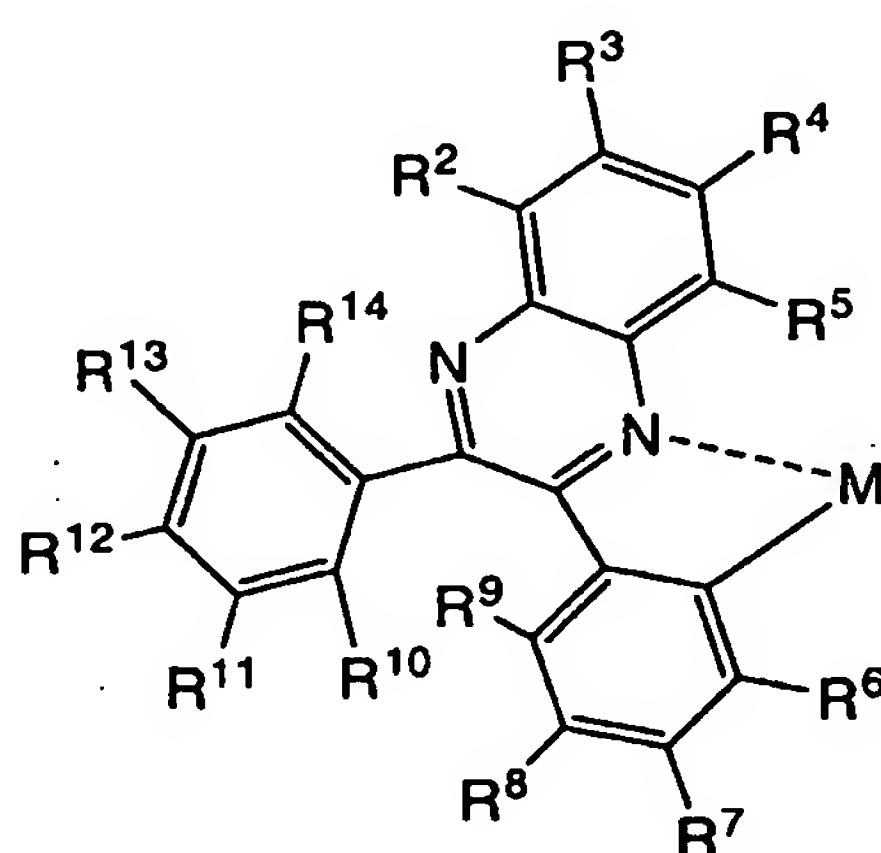
wherein each of R¹ to R⁹ is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, at least one of R⁶ to R⁹ is an electron-withdrawing group, and M is one of an element of Group 9 and an element of Group 10.

15

3. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (3) and a compound that has a larger energy gap than the organometallic complex, and

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(3)

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wherein each of R² to R¹⁴ is selected from the group consisting of hydrogen, a

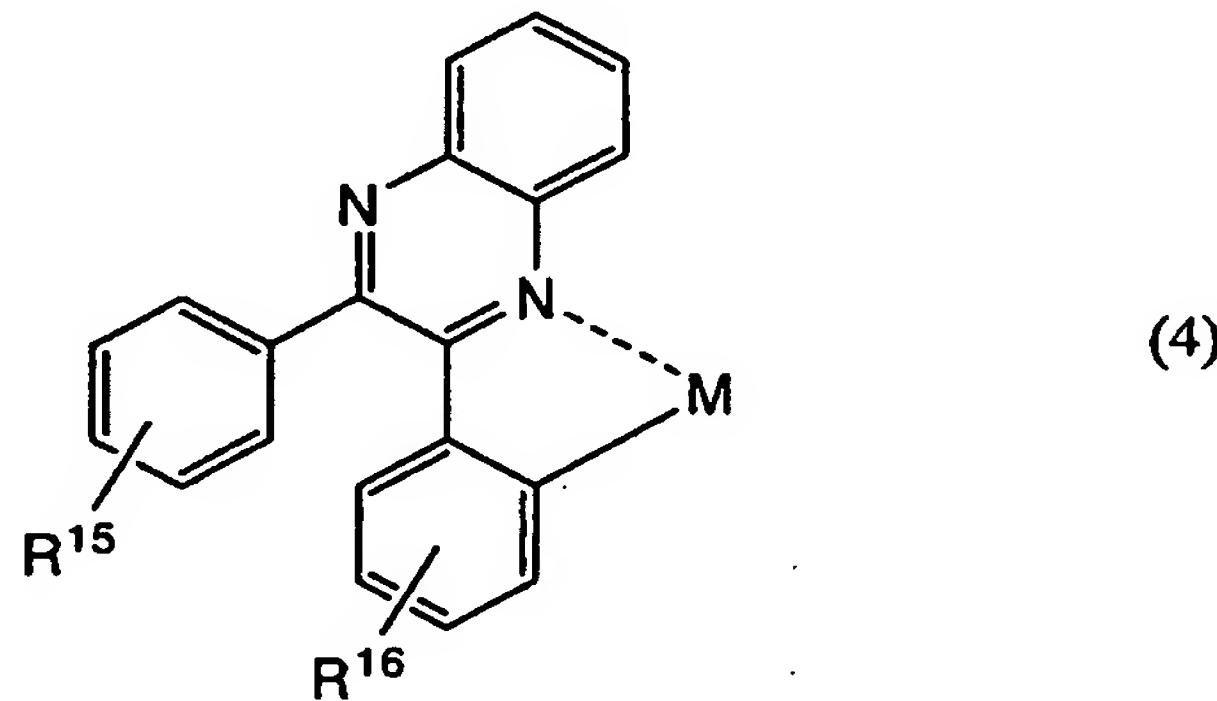
halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, and M is one of an element of Group 9 and an element of Group 10.

5 4. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (4) and a compound that has a larger energy gap than the organometallic complex, and

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wherein each of R¹⁵ and R¹⁶ is selected from the group consisting of hydrogen,

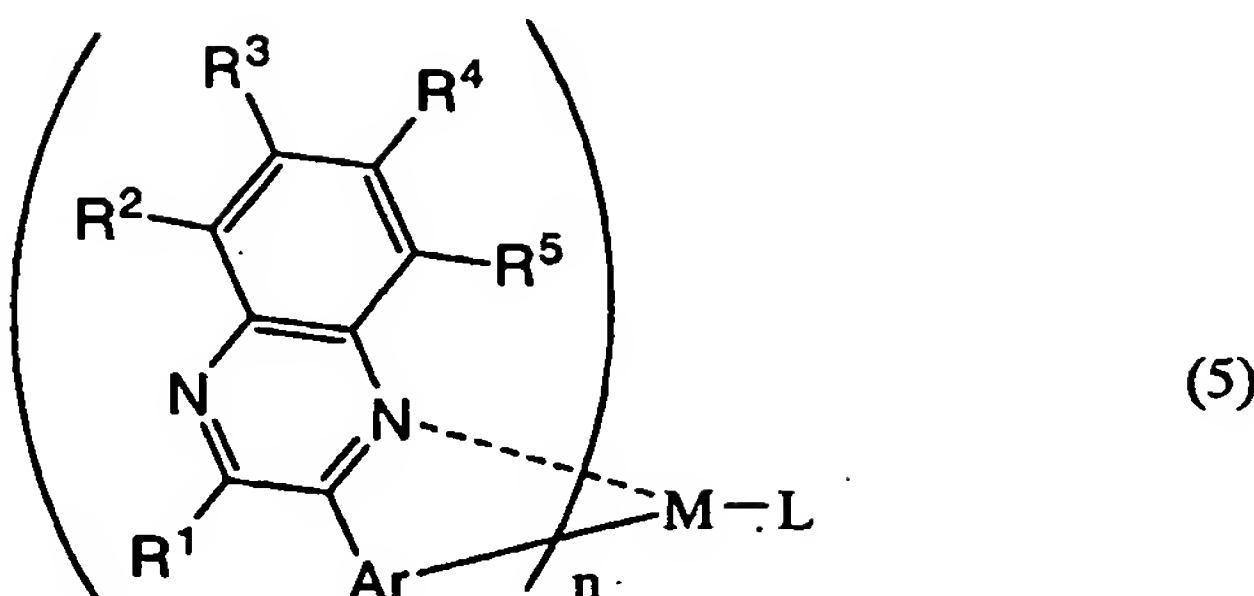
a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, and M is one of an element of Group 9 and an element of Group 10.

20

5. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (5) and a compound that has a larger energy gap than the organometallic complex, and

5



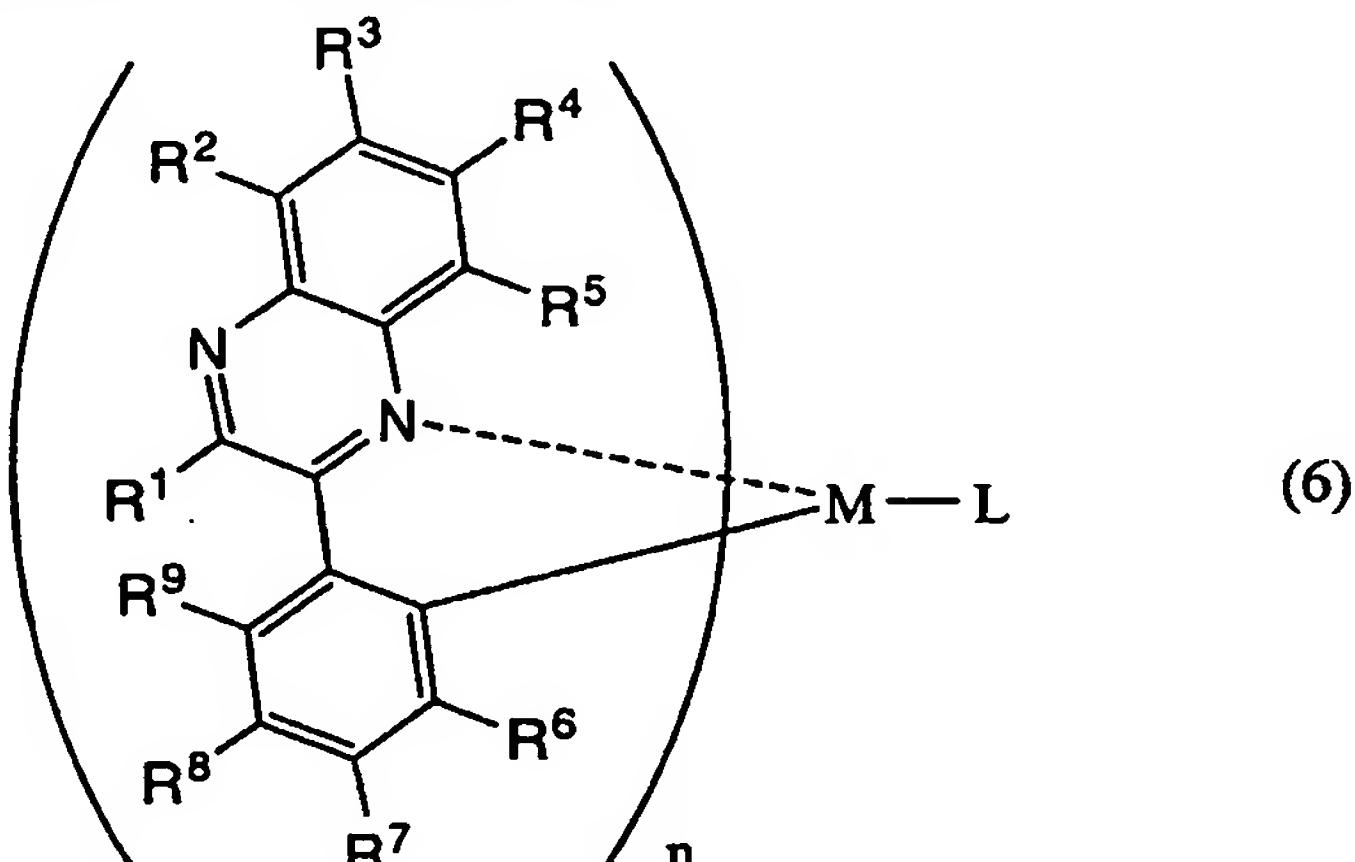
wherein each of \mathbf{R}^1 to \mathbf{R}^5 is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, \mathbf{Ar} is one of an aryl group having an electron-withdrawing group and a heterocyclic group having an electron-withdrawing group, \mathbf{M} is one of an element of Group 9 and an element of Group 10, $n = 2$ when the \mathbf{M} is the element of Group 9 while $n = 1$ when the \mathbf{M} is the element of Group 10, and \mathbf{L} is an anionic ligand.

15 6. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (6) and a compound that has a larger energy gap than the organometallic complex, and

20

25



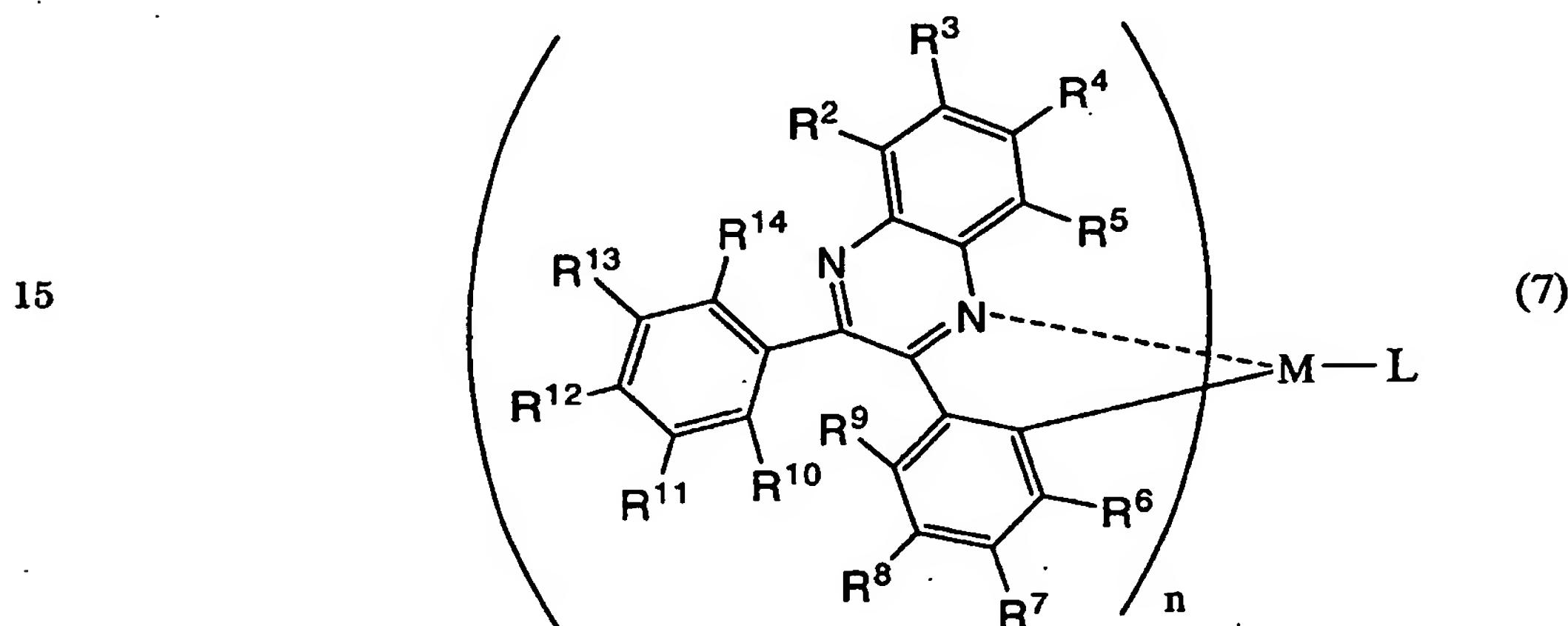
wherein each of \mathbf{R}^1 to \mathbf{R}^9 is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a

cyano group, and a heterocyclic group, at least one of R^6 to R^9 is an electron-withdrawing group, M is one of an element of Group 9 and an element of Group 10, $n = 2$ when the M is the element of Group 9 while $n = 1$ when the M is the element of Group 10, and L is an anionic ligand.

5

7. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (7) and a compound that has a larger
10 energy gap than the organometallic complex, and



20 wherein each of R^2 to R^{14} is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, M is one of an element of Group 9 and an element of Group 10, $n = 2$ when the M is the element of Group 9 while $n = 1$ when the M is the element of Group 10, and L is an anionic ligand.

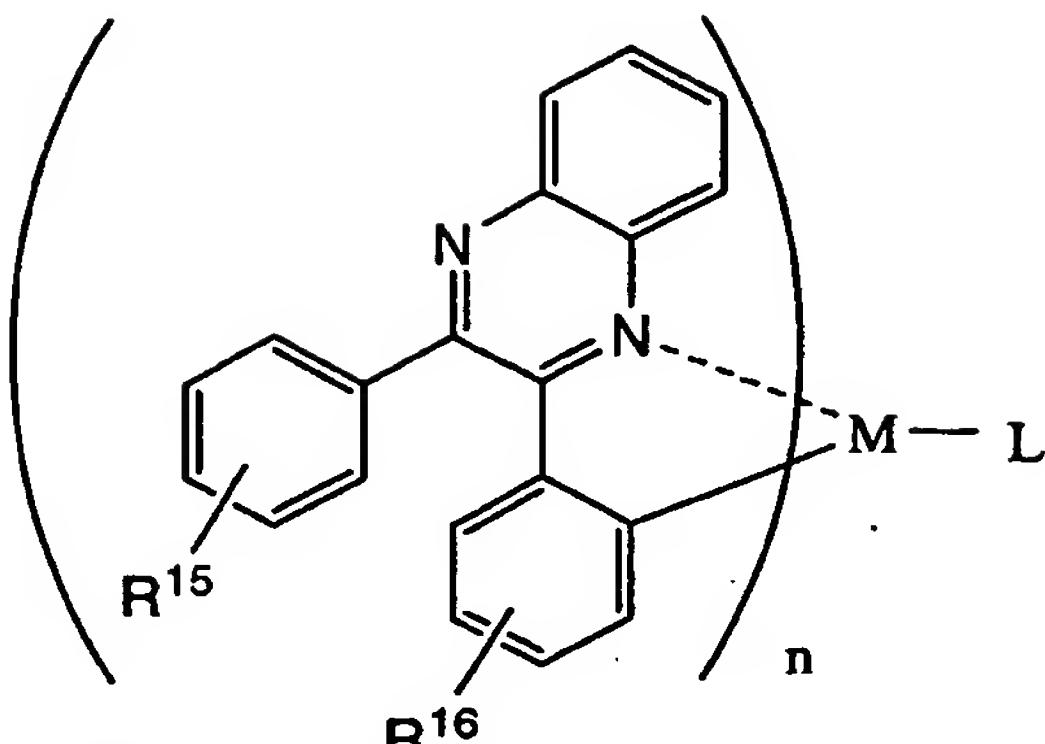
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8. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (8) and a compound that has a larger
30 energy gap than the organometallic complex, and

5

(8)

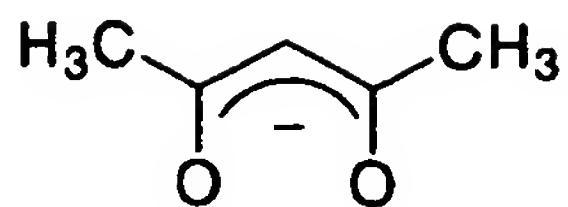


wherein each of R^{15} and R^{16} is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, M is one of an element of Group 9 and an element of Group 10, $n = 2$ when the M is the element of Group 9 while $n = 1$ when the M is the element of Group 10, and L is an anionic ligand.

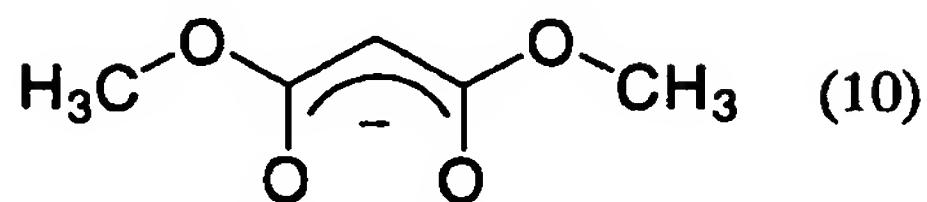
9. The light-emitting element according to any one of claims 1 to 8, wherein
15 the compound that has the larger energy gap than the organometallic complex is one of
4, 4' - bis [N - (1 - naphthyl) - N - phenylamino] - biphenyl and tris (8 - quinolinolato)
aluminum.

10. The light-emitting element according to any one of claims 5 to 8, wherein
20 the anionic ligand L is one of an anionic ligand having a β -diketone structure, an
anionic bidentate ligand having a carboxyl group, and an anionic bidentate ligand
having a phenolic hydroxyl group.

11. The light-emitting element according to any one of claims 5 to 8, wherein
25 the anionic ligand L is a ligand represented by any one of the following formulas (9) to
(15).

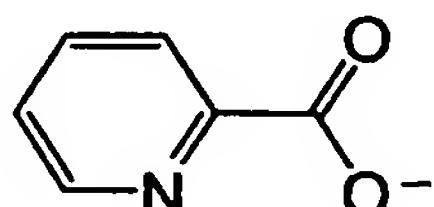


(9)

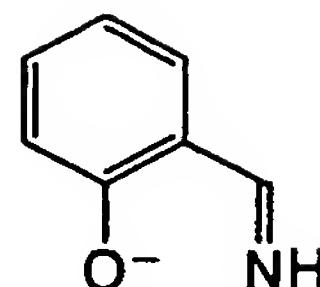


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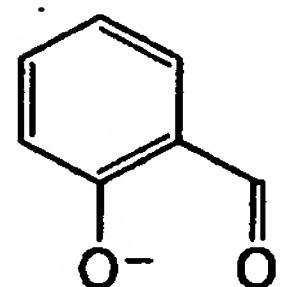
(10)



(11)

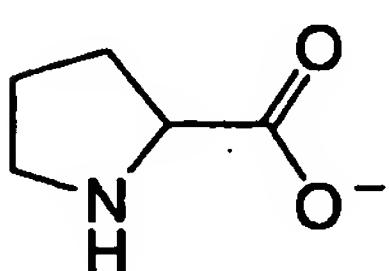


(13)

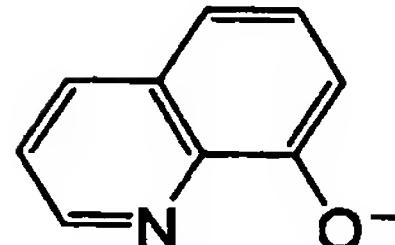


(14)

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(12)



(15)

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12. The light-emitting element according to any one of claims 1 to 8, wherein the light-emitting layer includes the organometallic complex and one of a first compound that has a larger energy gap than the organometallic complex and has an electron mobility of 10^{-6} cm²/Vs or more and a second compound that has a larger energy gap than the organometallic complex and has a hole mobility of 10^{-6} cm²/Vs or more.

13. The light-emitting element according to any one of claims 1 to 8, wherein the light-emitting layer includes the organometallic complex, a first compound that has a larger energy gap than the organometallic complex and has an electron mobility of 10^{-6} cm²/Vs or more, and a second compound that has a larger energy gap than the organometallic complex and has a hole mobility of 10^{-6} cm²/Vs or more.

14. The light-emitting element according to claim 12, wherein the first compound is a metal complex, and the second compound is an aromatic amine compound.

15. The light-emitting element according to claim 13, wherein the first compound is a metal complex, and the second compound is an aromatic amine compound.

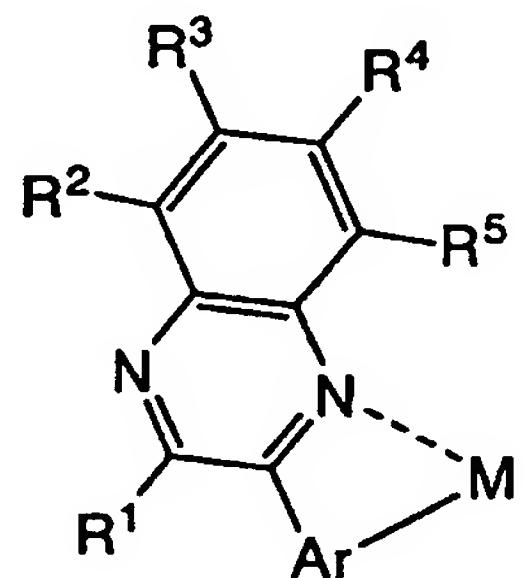
5

16. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (1) and a compound that has a 10 larger ionization potential and a smaller electron affinity than the organometallic complex, and

15

(1)



wherein each of R¹ to R⁵ is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a 20 cyano group, and a heterocyclic group, Ar is one of an aryl group having an electron-withdrawing group and a heterocyclic group having an electron-withdrawing group, and M is one of an element of Group 9 and an element of Group 10.

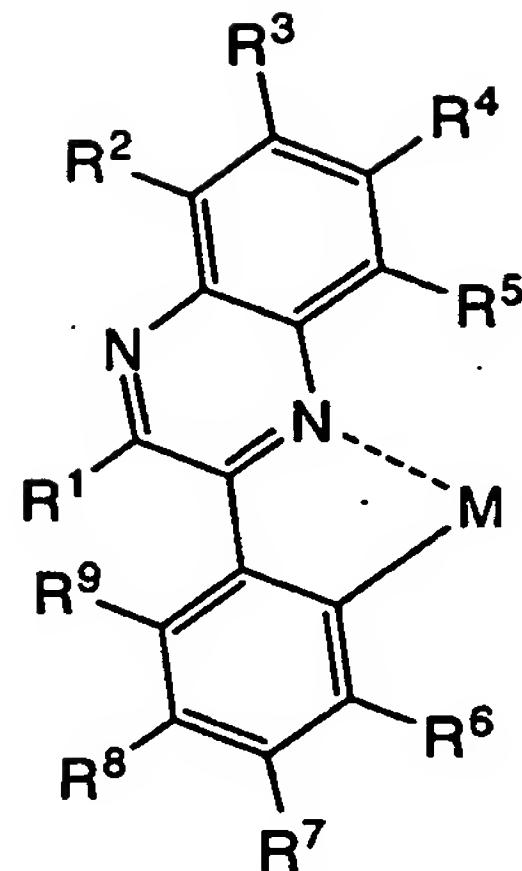
17. A light-emitting element comprising a light-emitting layer between a pair 25 of electrodes,

wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (2) and a compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex, and

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(2)

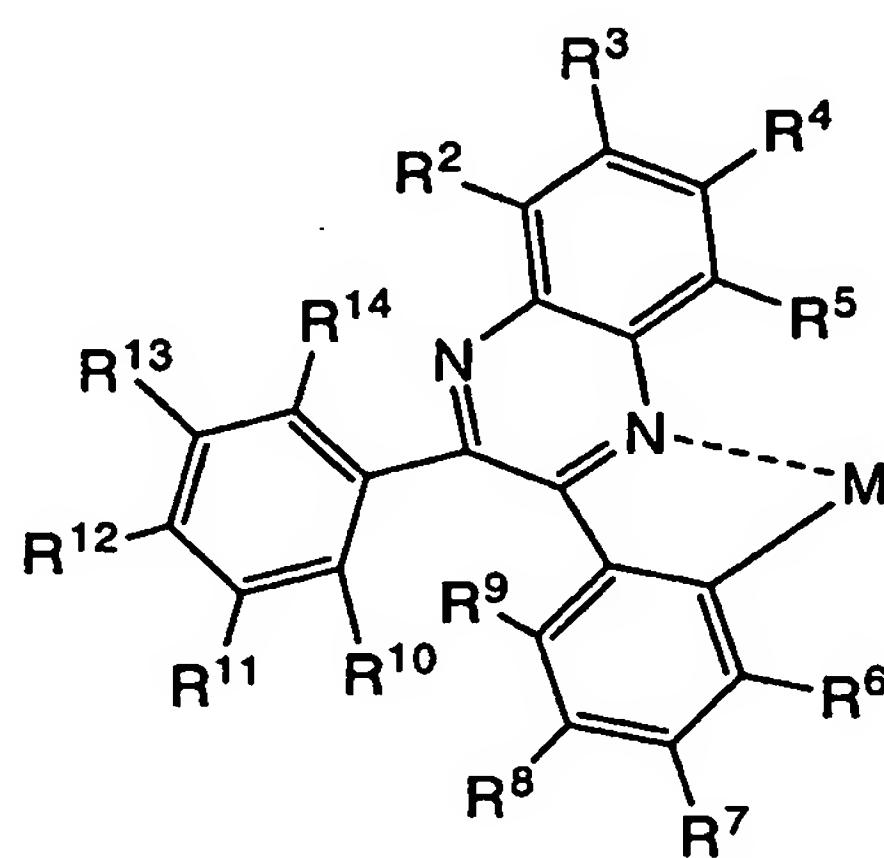
wherein each of R¹ to R⁹ is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, and M is one of an element of Group 9 and an element of Group 10.

18. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (3) and a compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex, and

25

30



(3)

wherein each of \mathbf{R}^2 to \mathbf{R}^{14} is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, and \mathbf{M} is one of an element of Group 9 and an element of Group 10.

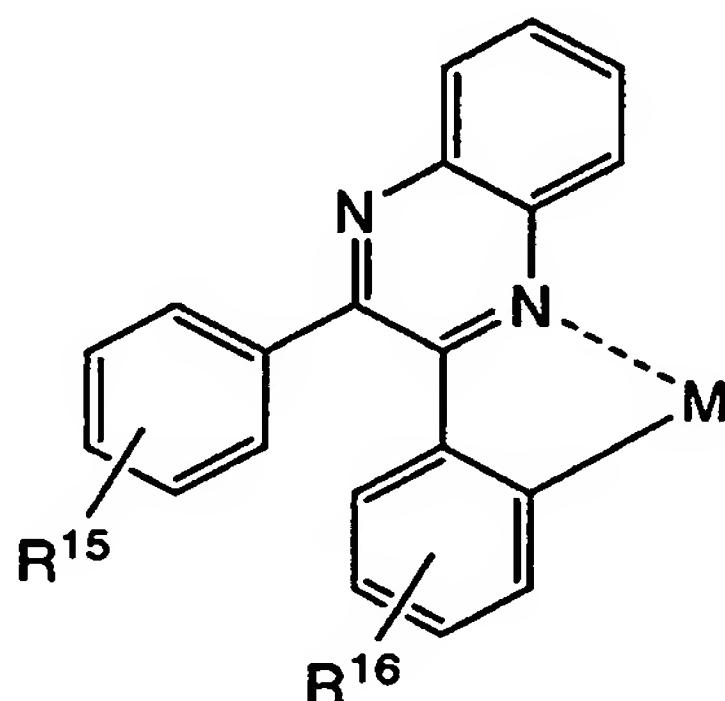
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19. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex having a structure represented by the following general formula (4) and a compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex, and

15

(4)



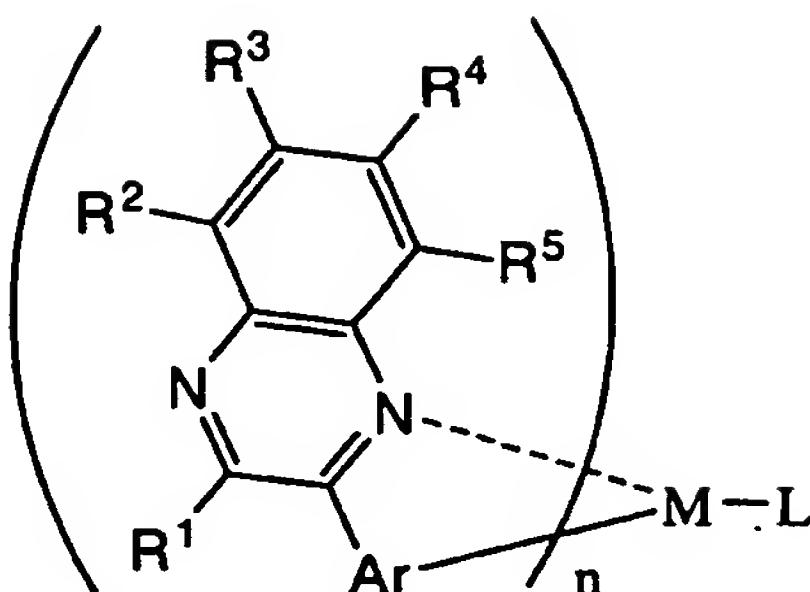
wherein each of \mathbf{R}^{15} and \mathbf{R}^{16} is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, and \mathbf{M} is one of an element of Group 9 and an element of Group 10.

25

20. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (5) and a compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex, and

5



wherein each of \mathbf{R}^1 to \mathbf{R}^5 is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, \mathbf{Ar} is one of an aryl group having an electron-withdrawing group and a heterocyclic group having an electron-withdrawing group, \mathbf{M} is one of an element of Group 9 and an element of Group 10, $n = 2$ when the \mathbf{M} is the element of Group 9 while $n = 1$ when the \mathbf{M} is the element of Group 10, and \mathbf{L} is an anionic ligand.

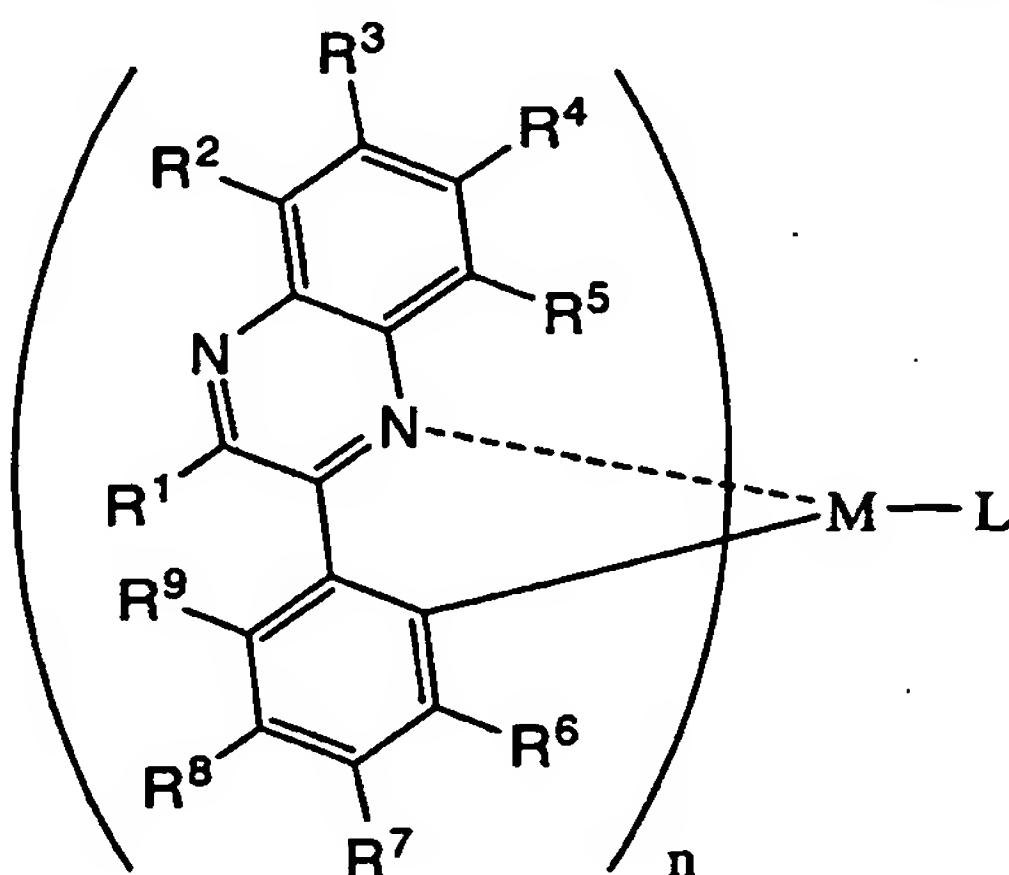
15

21. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (6) and a compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex, and

20

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wherein each of \mathbf{R}^1 to \mathbf{R}^9 is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a

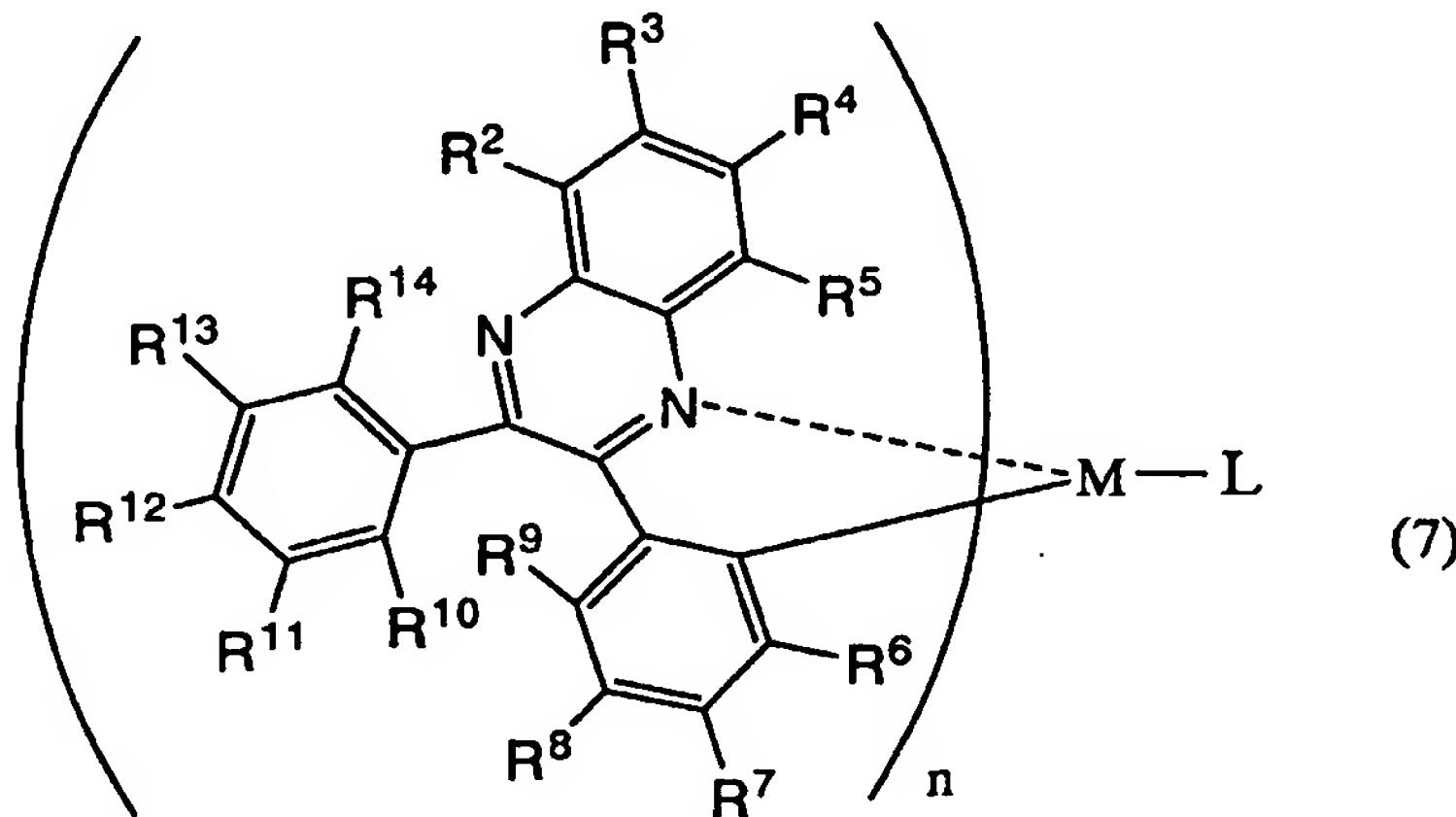
cyano group, and a heterocyclic group, at least one of \mathbf{R}^6 to \mathbf{R}^9 is an electron-withdrawing group, \mathbf{M} is one of an element of Group 9 and an element of Group 10, $n = 2$ when the \mathbf{M} is the element of Group 9 while $n = 1$ when the \mathbf{M} is the element of Group 10, and \mathbf{L} is an anionic ligand.

5

22. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (7) and a compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex, and

15



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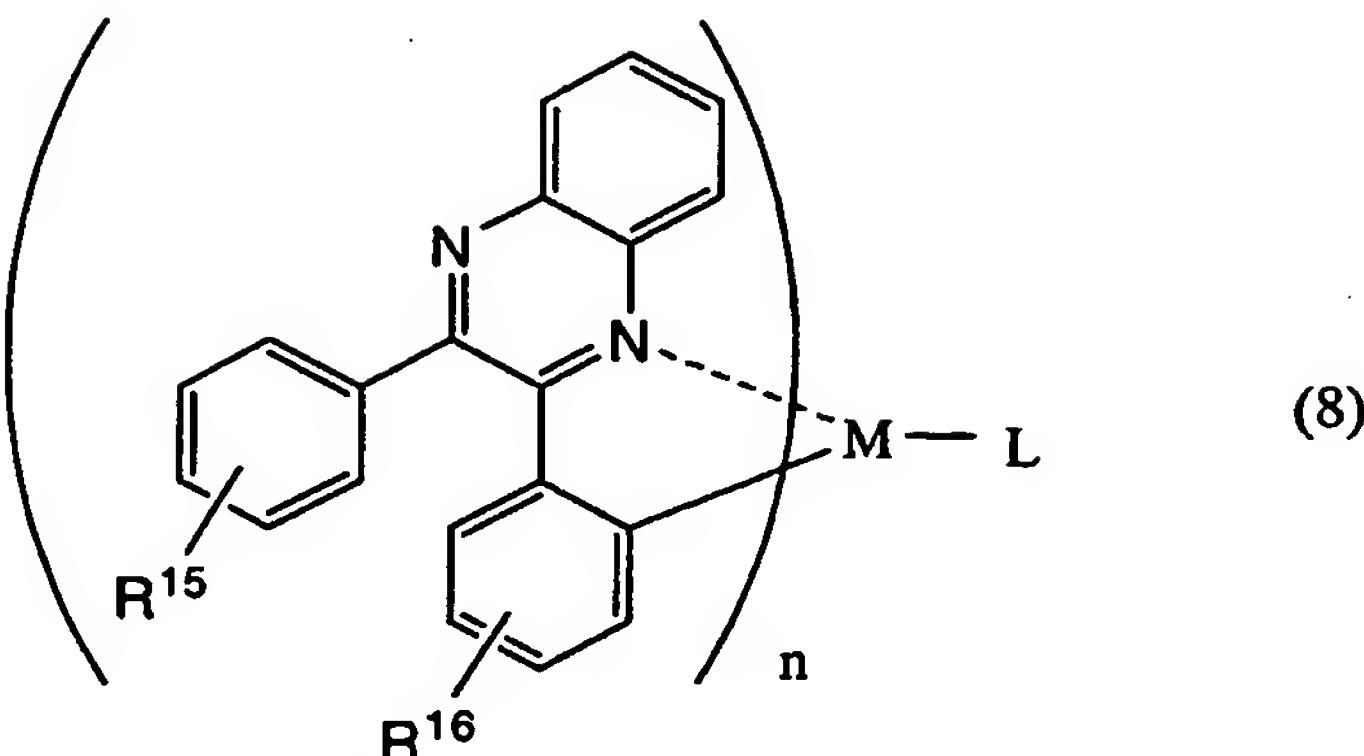
wherein each of \mathbf{R}^2 to \mathbf{R}^{14} is selected from the group consisting of hydrogen, a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, \mathbf{M} is one of an element of Group 9 and an element of Group 10, $n = 2$ when the \mathbf{M} is the element of Group 9 while $n = 1$ when the \mathbf{M} is the element of Group 10, and \mathbf{L} is an anionic ligand.

25

23. A light-emitting element comprising a light-emitting layer between a pair of electrodes,

wherein the light-emitting layer comprises an organometallic complex represented by the following general formula (8) and a compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex, and

5



wherein each of R^{15} and R^{16} is selected from the group consisting of hydrogen,
 10 a halogen element, an acyl group, an alkyl group, an alkoxy group, an aryl group, a cyano group, and a heterocyclic group, M is one of an element of Group 9 and an element of Group 10, $n = 2$ when the M is the element of Group 9 while $n = 1$ when the M is the element of Group 10, and L is an anionic ligand.

15

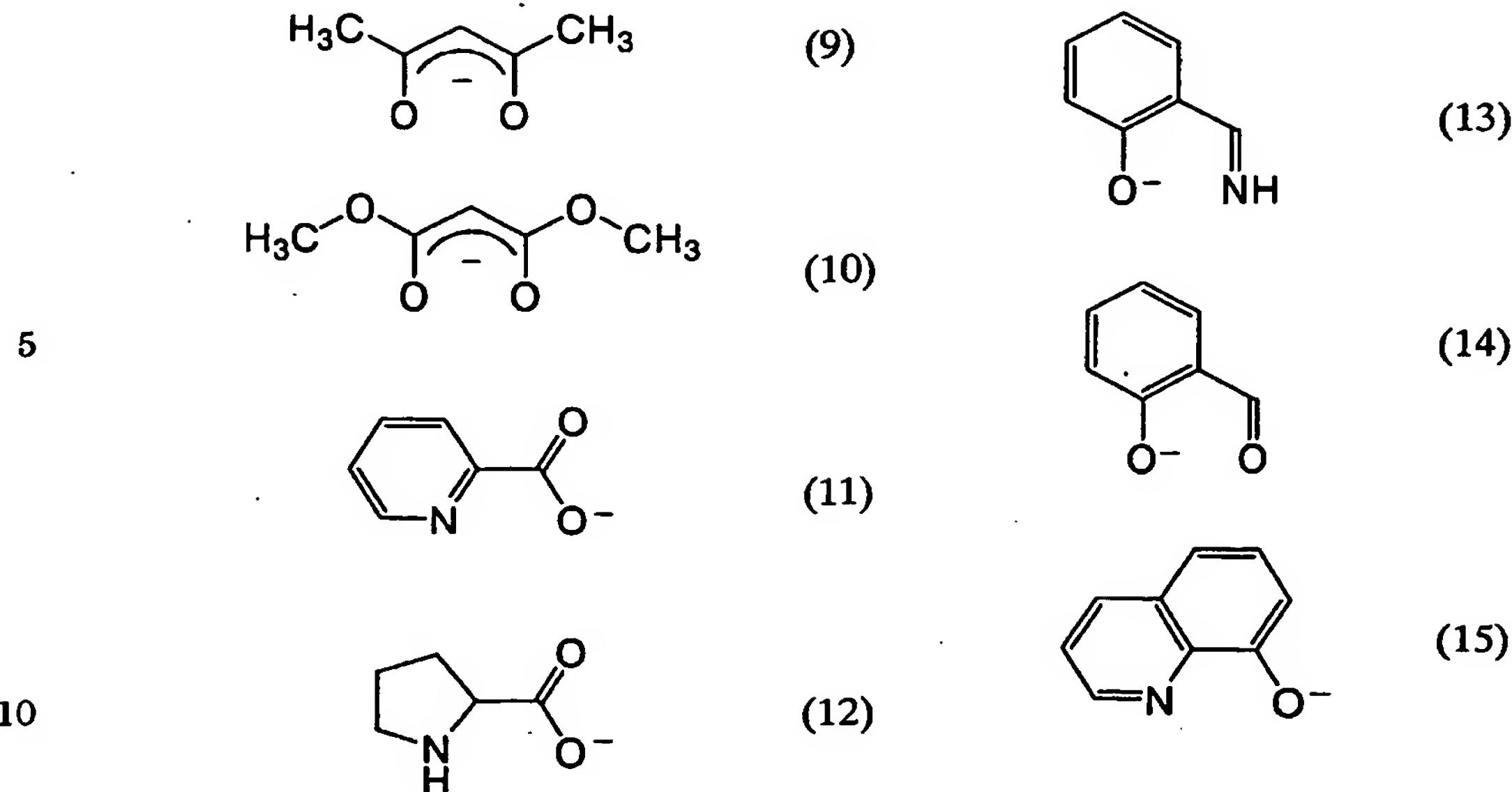
24. The light-emitting element according to any one of claims 20 to 23, wherein the anionic ligand L is one of an anionic ligand having a β -diketone structure, an anionic bidentate ligand having a carboxyl group, and a monoanionic bidentate ligand having a phenolic hydroxyl group.

20

25. The light-emitting element according to any one of claims 20 to 23, wherein the anionic ligand L is a ligand represented by any one of the following formulas (9) to (15).

25

30



26. The light-emitting element according to any one of claims 16 to 23, wherein the light-emitting layer includes the organometallic complex and one of a first compound that has a larger ionization potential and a smaller electron affinity than the 15 organometallic complex and has an electron mobility of $10^{-6} \text{ cm}^2/\text{Vs}$ or more and a second compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex and has a hole mobility of $10^{-6} \text{ cm}^2/\text{Vs}$ or more.

27. The light-emitting element according to any one of claims 16 to 23, 20 wherein the light-emitting layer includes the organometallic complex, a first compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex and has an electron mobility of $10^{-6} \text{ cm}^2/\text{Vs}$ or more, and a second compound that has a larger ionization potential and a smaller electron affinity than the organometallic complex and has a hole mobility of $10^{-6} \text{ cm}^2/\text{Vs}$ or more.

25

28. The light-emitting element according to claim 26, wherein the first compound is a metal complex, and the second compound is an aromatic amine compound.

30 29. The light-emitting element according to claim 27, wherein the first

compound is a metal complex, and the second compound is an aromatic amine compound.

30. The light-emitting element according to any one of claims 1 to 8, further comprising at least one of a hole injecting layer, a hole transporting layer, a hole blocking layer, an electron transporting layer, and an electron injecting layer.

31. The light-emitting element according to any one of claims 16 to 23, further comprising at least one of a hole injecting layer, a hole transporting layer, a hole blocking layer, an electron transporting layer, and an electron injecting layer.

32. A light-emitting device using the light-emitting element according to any one of claims 1 to 8.

33. A light-emitting device using the light-emitting element according to any one of claims 16 to 23.